

**APPARATUS FOR READING A DATA STORAGE MEDIUM
CROSS-REFERENCE TO RELATED APPLICATION**

This application claims priority of Taiwanese Application No. 091219457, filed on December 2, 2002.

5 **BACKGROUND OF THE INVENTION**

1. Field of the Invention

The invention relates to an apparatus for reading a data storage medium, more particularly to an apparatus for reading a data storage medium that is convenient
10 to carry.

2. Description of the Related Art

Optical disks have been widely used as a data storage medium. However, a conventional apparatus for reading an optical disk, which has a diameter of 12 cm and a
15 memory capacity of 650M bytes, has a relatively large size, and is thus inconvenient to carry.

SUMMARY OF THE INVENTION

Therefore, the object of the present invention is to provide an apparatus for reading a data storage medium
20 that is convenient to carry.

According to one aspect of the present invention, there is provided an apparatus for reading a data storage medium. The data storage medium includes a rectangular card body that has a surface formed with a data storage
25 track having a plurality of parallel and equally spaced apart track sections that are stored with optically detectable information. The apparatus comprises:

a housing;

a carrier frame mounted movably in the housing and adapted to be loaded with the data storage medium thereon;

5 a first driving unit mounted in the housing and associated operably with the carrier frame, the first driving unit being operable so as to drive the carrier frame to move back and forth between first and second limit positions along a first direction parallel to the
10 track sections;

an optical detecting unit mounted movably in the housing and adapted for reading the optically detectable information stored in one of the track sections when the carrier frame is moved by the first driving unit
15 along the first direction;

a second driving unit mounted in the housing and associated operably with the optical detector unit, the second driving unit being operable so as to drive the optical detecting unit to move along a second direction
20 transverse to the first direction; and

a control unit mounted in the housing and coupled electrically to the first and second driving units and the optical detecting unit, the control unit controlling the first driving unit so as to enable the first driving
25 unit to drive the carrier frame to move back and forth between the first and second limit positions along the first direction, the control unit receiving the

optically detectable information read by the optical detecting unit and activating the second driving unit to move the optical detecting unit by a predetermined distance along the second direction upon detection that
5 the carrier frame has been moved by the first driving unit from one of the first and second limit positions to the other one of the first and second limit positions.

According to another aspect of the present invention, there is provided a data storage medium for storing
10 optically detectable information. The data storage medium comprises:

a sector card body having a surface that is formed with a data storage track having a plurality of equally spaced apart curved track sections that are adapted to
15 be stored with the optically detectable information.

According to a further aspect of the present invention, there is provided an apparatus for reading a data storage medium. The data storage medium includes a sector card
20 body having a surface that is formed with a data storage track having a plurality of equally spaced apart curved track sections that are stored with optically detectable information. The apparatus comprises:

a housing;

a pivot axle mounted rotatably in the housing and
25 adapted to be sleeved with the data storage medium thereon such that the data storage medium is rotated together with the pivot axle;

a first driving unit mounted in the housing and associated operably with the pivot axle, the first driving unit being operable so as to drive the pivot axle to rotate in clockwise and counterclockwise
5 directions so as to drive the data storage medium to rotate back and forth between first and second limit positions;

an optical detecting unit mounted movably in the housing and adapted for reading the optically detectable
10 information stored in one of the curved track sections when the data storage medium is rotated by the first driving unit;

a second driving unit mounted in the housing and associated operably with the optical detector unit, the
15 second driving unit being operable so as to drive the optical detecting unit to move along a radial direction relative to the pivot axle; and

a control unit mounted in the housing and coupled electrically to the first and second driving units and
20 the optical detecting unit, the control unit controlling the first driving unit so as to enable the first driving unit to drive the data storage medium to rotate back and forth between the first and second limit positions, the control unit receiving the optically detectable
25 information read by the optical detecting unit and activating the second driving unit to move the optical detecting unit by a predetermined distance along the

radial direction upon detection that the data storage medium has been moved by the first driving unit from one of the first and second limit positions to the other one of the first and second limit positions.

5 **BRIEF DESCRIPTION OF THE DRAWINGS**

Other features and advantages of the present invention will become apparent in the following detailed description of the preferred embodiments with reference to the accompanying drawings, of which:

10 Figure 1 is a perspective view showing the first preferred embodiment of an apparatus for reading a data storage medium according to the present invention;

Figure 2 is an exploded perspective view showing the first preferred embodiment;

15 Figure 3 is a schematic electrical circuit block diagram illustrating the first preferred embodiment;

Figure 4 is a schematic sectional view showing the relationship between a first driving unit and a carrier frame in the first preferred embodiment;

20 Figures 5 to 7 are schematic top views illustrate movement of the carrier frame between first and second limit positions;

Figure 8 is schematic view showing a display of the first preferred embodiment;

25 Figure 9 is a schematic sectional view showing a guide unit of the first preferred embodiment;

Figure 10 is a schematic sectional view showing a

guide unit of the second preferred embodiment of an apparatus for reading a data storage medium according to the present invention;

5 Figure 11 is a schematic sectional view showing a first driving unit of the third preferred embodiment of an apparatus for reading a data storage medium according to the present invention;

10 Figure 12 is a schematic view showing the relationship between a first driving unit and a carrier frame in the fourth preferred embodiment of an apparatus for reading a data storage medium according to the present invention;

15 Figure 13 is a schematic view showing the relationship between a first driving unit and a carrier frame in the fifth preferred embodiment of an apparatus for reading a data storage medium according to the present invention; and

Figure 14 is a schematic view showing the sixth preferred embodiment of an apparatus for reading a data storage medium according to the present invention.

20 **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

Before the present invention is described in greater detail, it should be noted that like elements are denoted by the same reference numerals throughout the disclosure.

25 Referring to Figures 1 to 3, the first preferred embodiment of an apparatus for reading a data storage medium 9 according to the present invention is shown.

The data storage medium 9 includes a rectangular card body 90 that has a surface formed with a data storage track having a plurality of parallel and equally spaced apart track sections 900 which are stored with optically detectable information. The apparatus includes a housing 1, a carrier frame 2, a first driving unit 3, an optical detecting unit 4, a second driving unit 6, and a control unit 5 coupled electrically to the first and second driving units 3, 6 and the optical detecting unit 4.

The carrier frame 2 is mounted movably in the housing 1 and is adapted to be loaded with the data storage medium 9 therein. In this embodiment, the carrier frame 2 has opposite ends 21, and a bottom surface 22 formed with a pivot post 221 (see Figure 2).

In this embodiment, the housing 1 includes a hollow base 10 and a cover 11. The base 10 houses the carrier frame 2, the first driving unit 3 and the control unit 5 therein, and has an open top end 101 such that the data storage medium 9 is adapted to be disposed on and taken away from the carrier frame 2 via the open top end 101. The cover 11 is connected pivotally to the base 10 and is operable so as to move between a closed position, where the cover 11 closes the open top end 101 of the base 10, and an opened position, where an angle is formed between the cover 11 and the base 10. The cover 11 has an inner surface 111 formed with a

receiving groove 12 for receiving the optical detecting unit 4 and the second driving unit 6, and an outer surface 112 opposite to the inner surface 111.

The first driving unit 3 is mounted in the base 10 of the housing 1 and is associated operably with the carrier frame 2. The first driving unit 3 is operable so as to drive the carrier frame 2 to move back and forth between first and second limit positions along a first direction (A) parallel to the track sections 900. In this embodiment, the first driving unit 3 includes a bi-directional motor 34, a circular plate 30 and a connecting rod 32. The bi-directional motor 34 is mounted in the base 10 and is disposed below the carrier frame 2. The bi-directional motor 34 has a drive shaft 35 extending along an axis 33 that is transverse to the bottom surface 22 of the carrier frame 2. The plate 30 is mounted on the drive shaft 35 so as to rotate together therewith and is disposed below the carrier frame 2. The plate 30 is formed with a pivot post 31. The connecting rod 32 is disposed between the plate 30 and the carrier frame 2 and has opposite ends 320 that are coupled pivotally to the pivot posts 221, 31 of the carrier frame 2 and the plate 30, respectively, as shown in Figure 4. The bi-directional motor 34 is connected to and is controlled by the control unit 5 such that rotation of the plate 30 in clockwise and counterclockwise directions results in back and forth

movement of the carrier frame 2 between the first and second limit position along the first direction (A), as shown in Figures 5 to 7.

5 The optical detecting unit 4, such as a CMOS sensor array or a charge-coupled-device array, is mounted movably in the receiving groove 12 of the cover 11 and is adapted for reading the optically detectable information stored in one of the track sections 900 when the carrier frame 2 is moved by the first driving unit
10 3 along the first direction (A).

The second driving unit 6 is mounted in the cover 11 of the housing 1 and is associated operably with the optical detecting unit 4. The second driving unit 6 is operable so as to drive the optical detecting unit
15 4 to move along a second direction (B) transverse to the first direction (A). In this embodiment, the second driving unit 6 includes a bi-directional motor unit 61 disposed in the cover 11 and having a threaded guide shaft 60 that extends in the receiving groove 12 along
20 a third direction (C) parallel to the inner surface 111 and transverse to the first direction (A). The optical detecting unit 4 is sleeved threadedly on the threaded guide shaft 60. The bi-directional motor unit 61 is connected to and is controlled by the control unit 5
25 so as to enable the threaded guide shaft 60 to drive the optical detecting unit 4 to move along the second direction (B) when the cover 11 is disposed in the closed

position.

The control unit 5, which is mounted in the base 10 of the housing 1, controls the first driving unit 3 so as to enable the first driving unit 3 to drive the carrier frame 2 to move back and forth between the first and second limit positions along the first direction (A). The control unit 5 receives the optically detectable information read by the optical detecting unit 4 and activates the second driving unit 6 to move the optical detecting unit 4 by a predetermined distance along the second direction (B) upon detection that the carrier frame 2 has been moved by the first driving unit 3 from one of the first and second limit positions to the other one of the first and second limit positions. It is noted that the predetermined distance is equal to a distance between adjacent ones of the track sections 900 such that, when the second driving unit 6 is activated by the control unit 5, the optical detecting unit 4 is moved away from an initial one of the track sections 900 and is brought into alignment with another one of the track sections 900 adjacent to the initial one of the track sections 900.

With further reference to Figures 3 and 5, a position detecting unit 53, which is disposed in the base 10, is coupled electrically to the control unit 5 for detecting position of the carrier frame 2. The position detecting unit 53 generates a signal to the control unit

5 upon detection that the carrier frame 2 has been moved to one of the first and second limit positions. In this embodiment, the position detecting unit 53 includes a pair of light emitters 531 and a pair of light sensors 532. The light emitters 531 are mounted on the bottom surface 22 of the carrier frame 2 and are spaced apart from each other in the first direction (A). The light sensors 532 are mounted in the base 10 and are spaced apart from each other in the first direction (A). One of the light sensors 532, which is adjacent to the first limit position, senses light emitted by a corresponding one of the light emitters 531 so as to generate the signal to the control unit 5 when the carrier frame 2 is moved to the first limit position. One of the light sensors 532, which is adjacent to the second limit position, senses light emitted by a corresponding one of the light emitters 531 so as to generate the signal to the control unit 5 when the carrier frame 2 is moved to the second limit position.

20 The control unit 5 is adapted to process the optically detectable information from the optical detecting unit 4 and to provide the optically detectable information to an external processing unit 7. The apparatus further includes a connector 15 mounted on the base 10 of the housing 1, as shown in Figure 2. The connector 15 is coupled electrically to the control unit 5 and is adapted to be coupled to the external processing unit 7 for

transmitting the optically detectable information to the external processing unit 7. In this embodiment, the connector 15 can be a USB connector, a PCMCIA connector or an RS232 connector. Alternatively, the
5 connector 15 may be replaced with a frequency signal generator (not shown) for wirelessly transmitting the optically detectable information to the external processing unit 7.

The apparatus further includes a power supply unit
10 52 mounted detachably on the base 10 of the housing 1 in any suitable manner for providing electric power to the apparatus, as shown in Figure 1.

With further reference to Figure 8, the apparatus further includes a display 8 mounted on the outer surface
15 112 of the cover 11 (see Figure 8) and coupled electrically to the control unit 5 (see Figure 1). The outer surface 112 of the cover 11 is provided with a plurality of function keys 17 for further operation.

With further reference to Figures 5 and 9, the
20 apparatus further includes a guide unit that is disposed in the base 10 for guiding movement of the carrier frame 2 along the first direction (A). In this embodiment, the guide unit includes a pair of parallel guide rods 13 and a pair of mounting seats 23. The guide rods 13
25 extend along the first direction (A) and are spaced apart from each other in the second direction (B) (see Figure 2). The carrier frame 2 is disposed on the guide rods

13. The mounting seats 23 are connected to the bottom surface 22 of the carrier frame 2 and are sleeved slidably and respectively on the guide rods 13 such that the carrier frame 2 is capable of sliding on the guide rods 13 along the first direction (A). In order to provide cushioning effect to the carrier frame 2, each of the mounting seats 23 is mounted with a plurality of spring-loaded rolling balls 24 that abut against the respective one of the guide rods 13, as shown in Figure 9.

Figure 10 illustrates a guide unit of the second preferred embodiment of an apparatus for reading a data storage medium according to this invention, which is a modification of the first preferred embodiment. Unlike the previous embodiment, the guide unit, which is disposed in the base 10, includes a pair of parallel guide blocks 13' extending along the first direction (A) and spaced apart from each other in the second direction (B). Each of the guide blocks 13' is formed with a guide groove 130 extending along the first direction (A). The opposite ends 21 of the carrier frame 2 are engaged slidably and respectively within the guide grooves 130 in the guide blocks 13' such that the carrier frame 2 is capable of sliding between the guide blocks 13' along the first direction (A). In order to provide cushioning to the carrier frame 2, each of the guide blocks 13' is mounted with a plurality of spring-loaded

rolling balls 25 in the guide groove 130 that abut against the respective one of the ends 21 of the carrier frame 2.

Figure 11 illustrates a first driving unit of the third preferred embodiment of an apparatus for reading a data storage medium according to this invention, which is a modification of the first preferred embodiment. In this embodiment, the first driving unit includes an elongated rack 14 and a gear 17. The rack 14 is mounted on one side of the carrier frame 2, which is parallel to the first direction (A). The gear 17 is driven to rotate by a bi-directional motor unit (not shown) under the control of the control unit about an axis 16 that is transverse to a plane formed by the guide rods 13, and meshes with the rack 34.

Figure 12 illustrates a first driving unit of the fourth preferred embodiment of an apparatus for reading a data storage medium according to this invention, which is a modification of the first preferred embodiment. Unlike the previous embodiments, the carrier frame 2' has a bottom surface 22' formed with a circular recess 222 that has an inner wall 223.

The first driving unit includes the aforesaid bi-directional motor 34 (not shown) and an eccentric wheel 36. The bi-directional motor 34 has a drive shaft 35 extending along an axis that is transverse to the bottom surface 22' of the carrier frame 2'. The

eccentric wheel 36 is mounted on the drive shaft 35,
is received in the recess 222, and abuts against the
inner wall 223 of the recess 222. A largest distance
between the drive shaft 35 and a periphery of the
5 eccentric wheel 36 is longer than a radius of the circular
recess 222. The bi-directional motor 34 is connected
to and is controlled by the control unit such that
rotation of the eccentric wheel 222 in clockwise and
counterclockwise directions results in back and forth
10 movement of the carrier frame 22' between the first and
second limit positions.

Figure 13 illustrates a first driving unit of the
fifth preferred embodiment of an apparatus for reading
a data storage medium according to this invention, which
15 is a modification of the first preferred embodiment.
Unlike the previous embodiments, the carrier frame 2"
has opposite conductive surfaces and opposite sides in
the second direction (B).

The first driving unit 3" includes two pairs of
20 elongated electromagnets 37 (only one pair is shown)
extending along the first direction (A). Each pair of
the electromagnets 37 is disposed adjacent to a
respective one of the sides of the carrier frame 2".
The electromagnets 37 in each pair are spaced apart from
25 each other and are disposed above and below the carrier
frame 2". The electromagnets 37 are connected to and
are controlled by the control unit 5 so as to generate

positive and negative magnetic fields in the first direction (A) when excited such that the carrier frame 2" is capable of moving back and forth between the first and second limit positions along the first direction (A) .

Figure 14 illustrates the sixth preferred embodiment of an apparatus for reading a data storage medium 9' according to the present invention, which is a modification of the first preferred embodiment. Unlike the previous embodiments, the data storage medium 9' includes a sector card body 90' having a surface that is formed with a data storage track having a plurality of equally spaced apart curved track sections 900' which are stored with optically detectable information. In this embodiment, a pivot axle 30", such as the drive shaft of a bi-directional motor, is used instead of the carrier frame described in the previous embodiments. The pivot axle 30" is mounted rotatably in the base 10 and is adapted to be sleeved with the data storage medium 9' thereon such that the data storage medium 9' is rotated together with the pivot axle 30". The first driving unit is operable so as to drive the pivot axle 30" to rotate in clockwise and counterclockwise directions so as to drive the data storage medium 9' to rotate back and forth between the first and second limit positions.

While the present invention has been described in connection with what is considered the most practical

and preferred embodiments, it is understood that this invention is not limited to the disclosed embodiments but is intended to cover various arrangements included within the spirit and scope of the broadest
5 interpretation so as to encompass all such modifications and equivalent arrangements.